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A Microgenetic Study of Postpartum Depression and Infant Development

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Abstract

Approximately 15% of mothers and 3-5% of fathers experience postpartum depression (DelRosario, 2013). Current literature suggests a negative association between maternal depression and infant development, but little is known about paternal contributions. Field (2010) found that mothers with depressive symptoms at 4 and 8 weeks postpartum reported frequent infant nighttime awakenings and less sleep during the night. Depressed mothers also reported more eating difficulties and lower infant weight gain than nondepressed mothers did (Gress-Smith, 2012). Moreover, infants of depressed mothers expected maternal unavailability and made less effort to engage the mother during the still face experiment (Field, 2002). In this microgenetic study, we examined both maternal and paternal depression and their associations with temperament and multiple indices of development from the last trimester to 3 months postpartum. At both times the parents completed the CES-D to assess mood changes (CESD; Radloff, 1977). At 3 months they completed questionnaires about infants' temperament and various infant outcomes. Infants and mothers also participated in the still face experiment (play for 3 minutes, still face for 2 minutes, recovery for 3 minutes). Depression of both parents in both time periods predicted infant communication milestones. Prenatal maternal depression scores were associated with fewer hours of sleeping during the night, a later bedtime, and more eating difficulties at 3 months. Fathers' depression was related with lower gross motor skills whereas mothers' depression was related with lower fine motor skills at 3 months. Prenatal and postnatal maternal depression predicted negative affect. Further, infants of nondepressed mothers used more gestures to engage mothers during the still face. Altogether, the findings demonstrate parental depression relates to multiple infant outcomes at 3 months, highlighting the need for longer longitudinal studies.

A Microgenetic Study on the Impact of Postpartum Depression on Infant Development

The birth of a child is generally accepted to be a joyous, momentous, event in a new couple's life. However, the event of childbirth is not a positive experience for all women. In fact, approximately 15% of women experience depression in the postpartum period (DelRosario, Chang, & Lee, 2013). Current trends in the literature suggest a largely negative association between maternal depression and healthy infant development. Research has focused extensively on the impact maternal depression has on the mother-infant dyad, but little has been done regarding the infant's emotional and physical development including the infant's growth, sleep, and eating patterns. Moreover, the effects of paternal depression are largely unknown. Additionally, the literature has yet to examine how individual differences in infant temperament might mitigate the negative consequences typically associated with early maternal depression. The author aims to shed light on these issues by investigating the relationship between parental depression and multiple indices of infant development while also considering individual differences in temperament.

Postpartum Depression: Symptoms and Etiology

According to the most recent version of the *Diagnostic and Statistical Manual of Mental Disorders*, depression with a peripartum onset is diagnosed when a mother presents with a mood episode during pregnancy or in the first four weeks postpartum (APA, 2013). It is important to note, however, that the definition is often expanded to include symptoms occurring up to one year postpartum (Segre & Davis, 2013). Specifically, women receiving this clinical diagnosis present to physicians with at least four of the following symptoms: changes in appetite or weight, sleep and psychomotor activity, decreased energy, feelings of worthlessness or guilt, difficulty thinking, concentrating, or making decisions, or recurrent thoughts of death or suicidal ideation,

plans or attempts (Segre & Davis, 2013). These symptoms must be present in mothers for at least two consecutive weeks and the mood episode "must be accompanied by clinically significant distress or impairment in social, occupational, or other important areas of functioning" (Segre & Davis, 2013). In more severe cases, some women present with psychotic symptoms including hallucinations and delusions. Although no single factor has been found to directly cause postpartum depression, researchers have explored multiple components that may contribute to its development.

Multiple studies have been conducted with the hopes of pinpointing the underlying cause of postpartum depression, but none have been entirely conclusive. The most largely studied factors have been predominantly psychosocial factors. O'Hara (2009) found the following risk factors to be associated with the development of postpartum depression: a previous depressive episode, depression and anxiety during pregnancy, postpartum blues, stressful life events (including childcare-related stressors), poor marital support, as well as poor social support. Other risk factors less frequently studied include low socioeconomic status (SES), obstetric factors (i.e. gestational diabetes, multiple gestations) and difficult infant temperament (O'Hara, 2009). It is presumed that the above risk factors result in heightened stress levels among women, and these in combination with varying hormonal levels collectively interact to result in postpartum depression.

Trends in the literature have shown that postpartum depression is also highly related to a woman's biological underpinnings. DelRosario et al. (2013) found the hormones estrogen, progesterone, serotonin, MAO-A and GABA levels were elevated in the third trimester of pregnancy, and then dropped rapidly in the postpartum period. It was likely that these hormonal

shifts contributed to a mother's experience of mood swings that could be symptoms of postpartum depression (DelRosario et al., 2013).

Skalkidou, Hellgren, Comasco, Sylven, and Poroma (2012) also examined the biological pathophysiology of postpartum depression. Skalkidou and colleagues focused particularly on the role oxytocin played both during pregnancy and in the postpartum period, as well as its potential to trigger postpartum depression. The hormone oxytocin appeared to have a mood ameliorating effect, and played a critical role in emotion regulation. For example, pain, stress, and anxiety were associated with diminished oxytocin release (Skalkidou et al., 2012). Women with high postpartum depression scores had significantly lower oxytocin levels than their nondepressed counterparts, suggesting that oxytocin was a contributing factor to postpartum depression.

Hendrick, Altshuler, and Suri (1998) extensively studied the hormonal changes that took place during and after pregnancy in women. They found that cortisol levels peaked in late pregnancy as a result of placental production of corticotropin. Corticotropin levels fell abruptly when the placenta was delivered. The authors speculated that the increase in cortisol that characterized late pregnancy, as a result of the placenta producing corticotropin-releasing hormone, might have caused adrenal suppression following delivery. If this adrenal suppression was severe and prolonged, it might have contributed to depressive mood changes after delivery (Hendrick et al., 1998).

Effects of Postpartum Depression on Infant Physical Development

Infants of depressed mothers are at a heightened risk for a variety of complications regarding their physical development including but not limited to their sleeping and eating patterns as well as issues with weight and height. Field (2010) examined the effects of postpartum depression on infant development and paid particular attention to infants' sleep

patterns. Field (2010) found that depressed mothers were more likely to place the infant to sleep in the prone position (stomach) instead of the supine position (back), which was recommended. She also found that mothers with depressive symptoms at 4 and 8 weeks reported that their infant cried frequently during the night, had frequent nighttime awakenings, and received less than 6 hours of sleep in a 24-hour period. Consistent with Field's findings, Pinheiro et al. (2011) found that as maternal depressive symptoms increased, so did infant sleep problems. They found that 35.8% of 12 month old infants in their sample with depressed mothers showed greater than two of the following dysfunctional sleep patterns at 12 months postpartum: sleeping less than 12 hours or more than 12 hours a night, frequent nighttime awakenings, absence of a sleep routine, and night terrors (Pinheiro et al., 2011).

Gress-Smith, Luecken, Lemery-Chalfant, and Howe (2012) evaluated how the presence of maternal depressive symptoms at 5 and 9 months postpartum impacted infant weight gain and overall physical health at 9 months of age. They found that the more depressive symptoms the mother displayed at 5 months postpartum, the more physical health concerns existed for their newborn infant. Specifically, they found that mothers with a prenatal onset of depression were more likely to have children with a low birth weight or a preterm birth. Additionally, infants of mothers with clinically significant levels of depression gained on average 2.93lbs from 5-9 months of age, where infants of nondepressed mothers gained approximately 5.16lbs (Gress-Smith et al., 2012). Lower birth weight has repeatedly been linked to poor developmental outcomes in children, particularly in regards to their cognitive development and language acquisition (Hack, Klein & Taylor, 1995).

Veltema, Conne-Perrreard, Bousquet, and Manzano (2002) examined multiple facets of infant well-being and development at 3 months of age in a population of both depressed and

nondepressed mothers. Interestingly, they found that depressed mothers stopped breastfeeding earlier than their nondepressed counterparts regardless of whether or not they resumed working. Additionally, they found that depressed mothers addressed their physicians with concerns regarding their infant's feeding behaviors with greater frequency than nondepressed mothers, and 29.3% of infants of depressed mothers had feeding difficulties at 3 months of age (Veltema et al., 2002). Field (2010) also found that postpartum depressed mothers discontinued breastfeeding earlier than nondepressed mothers. Mothers with high postpartum depression scores were significantly more likely to discontinue breastfeeding at 4-16 weeks postpartum, and they were giving the infant water, juice, or cereal during that time. Dennis and McQueen (2007) discovered that mothers reported being unsatisfied with breastfeeding and had experienced significant breastfeeding problems. Premature discontinuation of breastfeeding is of concern for the infant's physical development as it supports infant health.

Effects of Postpartum Depression on Infant Socio-Emotional Development

Many studies have shown the association between maternal depression and adverse outcomes in children. In particular, extensive research has been conducted on the developing relationship and interactions between the depressed mothers and their infants. Veltema, Bousquet, and Manzano (2003) found the postpartum depressed mother to be less positive, less contingent, and engaged in less vocal and play interaction. In response, the infants also displayed less positive affect and less contingent behavior because they had already internalized the interaction with the mother as predicted by attachment theory (Cohn, Campbell, & Ross, 1991). Although attachment patterns cannot be determined until the infant is 6 months of age, it has been well documented that infant attachment patterns can be predicted by early mother-infant interactions (Veltema et al., 2003). High maternal sensitivity during the first year of life is

associated later on with a secure pattern of attachment. Depressed mothers characteristically display less sensitivity towards their newborn, which can cause the child to be at risk for developing an insecure attachment style (Veltema et al., 2003).

Teti, Gelfand, Messinger, and Isabella (1995) reported a trend in the literature, which suggested that insecure infant attachments tended to be associated with mothers whose depression lasted beyond the first 6 months of giving birth. In specific, the more severely depressed the mother was, the more likely the child was to display an avoidant or resistant attachment style. Children characterized by avoidant attachment styles did not rely on the caregiver for support and emotional comfort (Simpson & Nelligan, 1992). Conversely, children with resistant attachments were ambivalent about their caregiver's ability to support them and hence, they inconsistently engaged the caregiver or accepted comfort (Simpson & Nelligan, 1992). Resistant attachment styles tend to reflect the child's uncertainty about the level of their caregiver's responsiveness and availability to their needs.

A popular way of examining the developing attachment style between infant and mother is through the still face experiment. The still face experiment contains 3 separate face-to-face play interactions lasting for approximately 3 minutes each. The first interaction, the "spontaneous interaction," involves the mother playing with her infant as she would if she was at home on a typical day. The second interaction requires the mother to maintain a "still face" which entails directing her gaze towards the infant, speaking in a monotone tone and maintaining an expressionless face while minimizing body movement (Cohn & Tronick, 1983). Finally, in the third interaction known as the "reunion," the mother is asked to resume her normal behavior and interaction patterns with her child, as if she was at home playing (Cohn & Tronick, 1983).

According to researchers such as Cohn, Campbell, and Ross (1991), the infant's behavior in this situation is not merely a response to the primary caregiver's absence, but is determined by the history of their daily interactions in different contexts. The procedure makes it clear that the infants have expectations about the mother's responsiveness and availability to meet their needs. In response to these expectations, the infants develop coping strategies to deal with their mother's unpredictability. The reactions the infants have to their mothers in the still face experiment are considered precursors to attachment styles. There is some evidence according to Ekas, Haltigan, & Messinger (2012) that 6-month-old infants of depressed mothers showed a faster decline in gazing at the mother during the still face period and tended to have an avoidant attachment at 18 months. Depressed mothers contribute to a heightened risk for an insecure infant attachment, as they take longer to match their infant's positive emotional states, and to repair a mismatch in affective state during the normal and repair phase of the procedure (Reck et al., 2011). This again leaves infants unsure of how their mothers will respond to their needs, opening the door to future insecure attachment.

Cohn and Tronick (1983) stated that infants were able to detect the affective quality of their mothers' displays and they modified their own affective display in response. The anxiety, elevated activity levels, and increased vocalizations shown by infants of nondepressed mothers appeared to be an attempt to reinstate their normal interaction (Cohn & Tronick, 1983). When they failed, their protesting and weariness carried over into the reunion interaction, which was exactly what Field (2002) found in her study.

Interested in seeing how the history of infants' daily interactions with their mothers determined their response to the Still Face Experiment, Field (2002) investigated whether infants of mothers who became depressed postpartum would behave like infants of nondepressed

mothers who were told to “look depressed.” She found that infants of nondepressed mothers showed more frequent positive facial expressions, less negative facial expressions, and more frequent vocalizations, protesting, and looking away during both the still face interaction and reunion phase. This suggests that infants of nondepressed mothers were not accustomed to their mothers being unresponsive to their needs, so they engaged in active coping styles where they fervently responded when their mother was apathetic, still, and uninvolved. Their anxiety at the sudden unresponsiveness of their mother was seen as they also had elevated activity levels and heart rates in comparison to infants of depressed mothers (Field, 2002). The behavior of the depressed mothers did not appear to change across the three situations and their infants too showed relatively unchanged behavior across the board. They showed less frequent vocalizations, protests, and movements, suggesting they had come to expect their mothers to be unresponsive to their needs. Interestingly, Field (2002) also found that infants of depressed mothers had lower heart rates, which has been associated with feelings of hopelessness and passive coping styles. Field’s (2002) findings, then, replicate and support the findings of Cohn and Tronick (1983), who developed the initial still face experiment.

The Role of Temperament on the Effects of Postpartum Depression on Infant Development

A possible factor that affects the influence that postpartum depression has on infant development is temperament. Temperament reflects biologically-based and relatively stable predispositions to respond in certain ways (Hill-Soderlund & Braumgart-Reiker, 2008). Individual differences in infant temperament are often characterized by the duration, intensity, and frequency of emotional reactions and the regulation of those reactions. Temperamental reactivity can be observed through the expression of negative emotions, including negative

vocalizations, facial grimaces, and crying in response to unfamiliar events (Hill-Soderlund & Braumgart-Reiker, 2008).

Some children have a greater propensity to act negatively, while others are able to better regulate their behavior and shift their attention in order to act more positively in upsetting situations (Montirsosso et al, 2011). Behavior typically can be regulated through reactive emotional systems such as fear, or through self-regulation systems such as effortful control. Both of these systems greatly impact a child's ability to regulate their social behavior (Hill-Soderlund & Braumgart-Reiker, 2008). Children who regulate their behavior using an emotional system such as fear demonstrate a more reactive and passive regulatory process. Rothbart, Ahadi, and Evans (2000) found individuals higher in temperamental fear and anxiety were more likely to be sensitive to certain social cues including punishment. Presumably then, children regulating their behavior with this type of system in the still face experiment would have a higher propensity to respond with negative emotionality such as vocalizations, higher activity levels, protests, as well as showing more distress to the unresponsive mother. These children are not as equipped to regulate their emotions in response to unfamiliar situations, so it would be expected that children with this regulatory approach would respond with heightened sensitivity regardless of whether or not their mother's unresponsiveness is characteristic of their day-to-day interactions.

In contrast, some children respond to novel situations with early features of effortful control. Examples of this reactive attentional control include gaze aversion and object orientation (Hill-Soderlund & Braumgart-Reiker, 2008). Gaze aversion is the ability to avert attention away from a stressor, so in the still face experiment, children with greater reactive attentional control would be better able to divert their attention away from the stressful situation of their mother being unresponsive to their bids for attention. Object orienting behavior allows the child to

disengage from the stressor and refocus on a neutral object, which is an early sign of emotion regulation (Hill-Soderlund & Braumgart-Reiker, 2008). Children with object orientating tendencies would perhaps direct their attention to an object other than their mother during the still face interaction in order to better control their negative emotions as a result of their mother's unresponsiveness (Hill-Soderlund & Braumgart-Reiker, 2008). It is likely then that children with this type of regulatory strategy would not appear as distressed to their mother during the still face interaction even if it was uncharacteristic of their typical experience with their mother.

It becomes evident then, that regulatory strategies and individual differences in temperament have important implications when examining the effects of maternal depression in infant development. Infants of depressed mothers may elicit vocalizations, protests, and cries, while infants of nondepressed mothers may remain seemingly calm and complacent during the still face not as a result of the absence or presence of depression, but as a result of individual differences in temperament. It is for this reason that the author of the present study will examine the role temperament plays in the infant's response to the still face experiment in children of both depressed and nondepressed mothers.

Fathers and Postpartum Depression

Research clearly points to the important role hormones play in the development of postpartum depression in women and the consequences it can have on the newborn child's development. However, there is a wide gap in the literature regarding hormonal changes associated with the birth of a child in fathers. Findings from a 2011 longitudinal study including 624 Philippine men indicate that mens' testosterone levels dropped significantly when they became fathers. This decrease in testosterone that occurred with fatherhood reduced aggressive and competitive urges in men and enhanced nurturing responses towards the infant (Klotter,

2012). Recognizing that fathers as well as mothers can develop depression following the birth of a child is crucial for the infant and couple's well being. Men whose partners suffer from PPD are in fact more likely to be depressed themselves, which is again associated with infant developmental delays and behavior problems later on in life (Klotter, 2012). In fact, 3-5% of fathers experience depression following childbirth. To date, very few studies have been conducted regarding whether fathers can develop postpartum depression independently from maternal depression.

Diagnosing PPD in men is much more difficult due to stereotypes constructed in American society. Particularly, men are expected to "be a man" and "tough it out", and the birth of a child typically focuses attention heavily on the mother and newborn, altogether neglecting to consider the father's emotional well-being. Despite this, the findings of a Canadian pilot study suggested that fathers, whose partners suffered from PPD, self-reported several depressive symptoms of their own including lack of energy, irritability, change in appetite, and self-doubt (Klotter, 2012). These factors in combination with worry about their spouse and economic hardships produced severely depressed men.

Additionally, fathers have the potential to mitigate the harmful effects of depression on their infant's development if they are well supported. Although unable to compensate fully for an absentee mother, fathers have an increasingly important role to play in fostering learning opportunities for their young child. If supported, they are able to expose their infants to positive affect, infant directed speech, and symbolic play, all of which are important areas of growth and development (Sohr-Preston & Scaramella, 2006). Similarly, increased father involvement has been found to moderate the association between maternal depression and later childhood behavior problems (Sohr-Preston & Scaramella, 2006). The study of paternal

postpartum depression is a recent phenomenon that deserves additional time and consideration, as it is evident that PPD is not an individual problem rooted in the mother, rather, postpartum depression affects the whole family. It is for these reasons that the author of the present study will investigate the role of paternal depression in relation to maternal depression and infant development.

The Present Study

Approximately 15% of mothers and 3-5% of fathers experience depression during the postpartum period (DelRosario, Chang, & Lee, 2013). Therefore, the investigation of parental depression is important for understanding infant emotional and physical development, including the infant's growth, sleep, and eating patterns. Based on the research reviewed here, infants of depressed mothers present weight delays and sleeping problems, such as under and oversleeping, frequent nighttime awakenings, absence of a sleep routine, and night terrors (Pinheiro et al, 2011). Additionally, maternal depression has implications in early mother-infant interactions. Although attachment patterns cannot be determined until the infant is 6 months of age, it has been well documented that infant attachment patterns can be predicted by early mother-infant interactions in the context of the still face paradigm (Cohn, Campbell, & Ross, 1991). Because depressed mothers display less sensitivity towards their infants during the still face, these babies are not as reactive to the interruption of their interaction with their mothers and take longer to engage again during the recovery phase (Conradt & Ablot, 2010). These reactions have specifically been linked to insecure attachment later on (Cohn, Campbell, & Ross, 1991).

The previous findings come from several individual studies, but there has not been an investigation of multiple infant outcomes in one single study. Such an approach would allow conclusions to be made about how outcomes correlate with each other and which one is affected

the most. For example, do infants of depressed mothers experience difficulties in their growth and their early interactions? Which one seems to be affected the most? The present study included a comprehensive assessment of infant well-being by broadening measures of infant growth to include not only body measures and assessments of sleeping and eating problems, but also assessments of developmental milestones. One would expect that if infants of depressed mothers have slower growth rates, they should also be behind in reaching developmental milestones. It can also be predicted that infants of depressed mothers will experience negative consequences in multiple indices of well-being. An additional contribution is that while existing literature has only examined precursors to attachment in older infants, the author administered the still face experiment to 3-month-olds in order to examine how depression influences the precursors of a developing attachment between the infant and mother.

Moreover, few studies have investigated the effects on infant development when both parents (mother and father) have postpartum depression. The author addressed this gap in the literature by investigating the relationships of paternal depression, maternal depression, and indices of infant growth and development. It was expected that more negative outcomes would be found in infants who had two parents with elevated scores of depression.

However, variations in infant temperament including the duration, intensity, and frequency of emotional reactions may be a mediating factor in determining the developmental trajectory of infants exposed to parental depression. Currently, there is little research that investigated the role of temperament in the relationship between maternal depression and infant development. Some infants may demonstrate a higher sensitivity to parental depression simply because they have a greater propensity to respond negatively to emotional stimuli. On the other hand, some infants may be less or altogether unaffected by parental depression due to early

indicators of effortful control and strong self-regulation skills. The author addressed this issue by assessing infant temperament in order to understand how exactly infant temperament hindered or protected against negative developmental outcomes associated with parental depression.

While most studies simply provide correlational data between concurrent measures of depression and infant outcomes, the current study employed a longitudinal design in which parental depression was assessed prenatally as well as three months after the child's birth. This design allowed for the investigation of developmental stability or change in parental depression and the relationship between depression and infant outcomes. It was expected that mothers scoring high in depressive symptoms prenatally would show less positive affect and fewer vocalizations when interacting with the pretend baby doll in the prenatal period. The author expected these trends to continue into the postpartum period, and expected to observe those same patterns of decreased vocalization and emotionality during the still face experiment.

In sum, the author expanded upon indices of infant development and examined their relation to parental depression by using a longitudinal design. The author also examined how infant temperament might serve as a mediating factor between infant development and paternal depression. The author expected to find significant associations between parental depression and multiple indices of infant well-being and that these associations would be stronger when both parents experienced elevated postnatal depression scores. It was also expected that temperament would mitigate some of the potential negative consequences of parental depression.

Method

Participants

The sample included twenty-five couples and their infants. The mean age of infants was three months, 15% had a sibling, and the rest of the infants were first-born children. All babies

were born full term, were healthy at birth, and at 3 months the average weight was 13.6lbs and the average height was 24.7 inches. The mean age of the mothers was 31.48 and the mean age of the fathers was 34.04. The majority of the couples was married (80%) and had been so for 2.98 years. The rest of the couples had been living together for about 3.36 years. Approximately 17% of couples had prior marriages and 20% were not married. The majority of the sample was Caucasian (88%), Latino/a(s) (8%), African-American (4%), and Asian/Pacific Islander (4%). Eighty-eight percent of mothers and 79.2% of fathers had at least some college education. Sixty-four percent of mothers and 88% of fathers were employed full-time and 8% percent of mothers were not employed outside the home. Most of the families had an average gross yearly income of more than $55,001. The majority of infants were primarily cared for by their mothers at home for the first three months (Table 1 & Appendix A).

One third of the families were recruited from a K23 study about postpartum depression that took place at a major local medical research university. The principal investigator of that study was also a collaborator of the current project. The mothers were approached during their prenatal visit with their gynecologist at the medical center. A research assistant informed them about the present study. Interested expectant mothers gave consent to be contacted about participating in this study. The rest of the participants were recruited from birth classes at the local medical research university.

In order to participate, the mothers had to have a partner living with them who had committed to raising the child together. Women also had to be free of any current diagnosis and medication. In order to determine eligibility, women were screened by a trained clinical psychologist using the M.I.N.I. Neuropsychiatric Interview 5.0. The response rate from recruitment was about 15% and all women who were screened were eligible to participate.

Mothers received a $15.00 gift card for their participation during the screening and a money order of $90.00 at the completion of the study.

The study has been approved by the institutional review boards of both the medical research university (H-00001214) and the college the author is affiliated with (2013-31).

Procedure

Screening visit.

Willing pregnant women recruited from birth classes arrived at the psychology lab at a time convenient to them. After signing the consent form for the screening, they completed the Edinburgh Postnatal Depression Scale (EPDS; Cox et al, 1987) that assesses depression and the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) that assesses anxiety. A clinical psychologist then administered the M.I.N.I. Eligible women were then invited to schedule their prenatal visit with their partner.

Prenatal visit.

This visit took place at the psychology lab or at the couples' home and lasted less than two hours. After signing the consent form, the principal investigators explained that the visit would consist primarily of three kinds of tasks: an interview, completing questionnaires, and an interactive task with a hypothetical baby. The purpose of the interview was to elicit memories of how the partners' own caregivers worked together to raise them and the couples' expectation about how they would work together to raise their own child. Each prospective parent was interviewed individually while the other partner completed questionnaires about coparenting, their marital relationship, and mood changes.

Partners were then brought together to participate in the Lausanne Triadic Play task (LTP) during which the prospective parents interacted with a doll. The data from this task will not be used in the current study.

Postnatal visit.

The postnatal visit took place either at the psychology lab or at the couples' home three months after the infant was born. This visit took approximately 2 and ½ hours and consisted of interviews, completing questionnaires, and interactive tasks with the baby. If the baby was awake and not hungry, parents began the study with the interactive tasks. If the baby was asleep or nursing, the session began with parent interviews. While one parent was interviewed the other one completed the questionnaires. The questionnaires were about their coparenting, their relationship, and mood changes. The whole procedure was video-recorded.

The purpose of this interview was to assess the quality of the newly developed coparental relationship between partners. In addition to questionnaires about coparenting, one of the parents completed the questionnaires about the baby's temperament, eating, sleeping, and developmental milestones. The LTP procedure was repeated again, this time with the baby sitting securely in the infant seat.

The still face procedure followed the postnatal LTP procedure. Here, the mother was instructed to sit directly in front of her baby, who was sitting in the baby chair directly across from her. The mothers received the following instructions prior to beginning:

> Please play with your baby like you normally do but do not use any toys. We would like you to play for 3 minutes after we signal you to start. When you hear this tone, we need you to hold a still face. A still face means that you stare into the space in front of you, you do not make any emotional expression or sounds, and you do not talk to or touch

your baby. We want you to keep the still face for 2 minutes until you hear the tone again. This would be your signal to interact with your child again. Please continue to play for another 3 minutes until we let you know when to stop. They were warned that babies generally do not like it when the play ends and some may cry. They were told that if their baby cried steadily for more than 30 seconds they would be signaled to stop the still face and interact with their baby for 3 minutes. To capture this interaction, one camera recorded the mother, another the baby, and a third recorded both.

The baby's height and weight were recorded next. The parents were asked to remove the baby's clothing except for their diaper and to place their baby on the infant scale. The baby's weight was then recorded. The baby was then laid flat on his/her back on top of paper and one leg was stretched out. When the baby was correctly positioned, a mark was made by the baby's head and on the bottom of the baby's foot. The length of the baby was then recorded.

The couple was then thanked for their participation in the postnatal family assessment and reminded that this was the last study visit. Lastly, the couple was paid for completing the procedure.

Measures

Only the measures used for the purpose of this study are described here. These include the measures of depression, anxiety, and mood changes of the parents, as well as questionnaires about infant temperament, eating, sleeping, and developmental milestones.

Depression, anxiety, and mood changes.

Edinburgh postnatal depression scale (EPDS). The EPDS is a reliable and frequently used questionnaire in research to assess depression. The EPDS consists of 10 questions about how individuals have been feeling in the past 7 days. Examples are "I

have been able to laugh and see the funny side of things", and "I have blamed myself unnecessarily when things went wrong." Answer choices for all questions were the following: as much as I always would, not quite so much now, definitely not so much now, or not at all. Responses were scored 0, 1, 2, and 3 based on the seriousness of the symptom. The scale was administered during the screening visit. Completion time was 2-3 minutes.

Center for epidemiologic studies depression scale (CES-D). The CES-D, a reliable and frequently used questionnaire, was used to assess maternal and paternal depression prenatally and postnatally. The CES-D consists of 20 statements about emotional states and participants rated the degree to which they had felt that way during the past week. A 4 point likert rating scale (0= rarely, 1, 2, 3= mostly) was used. Example of items include "I was bothered by things that don't usually bother me" and "I felt hopeful about the future." (CESD; Radloff, 1977). Completion time was about 5 minutes.

The state-trait anxiety inventory (STAI). The STAI is a commonly used measure of trait and state anxiety. It can be used in clinical settings to diagnose anxiety and to distinguish it from other depressive syndromes. It is also frequently used as an indicator of caregiver distress. It consists of 40 statements about emotional states. Participants rated the degree to which they were feeling each one of them at the moment of completing the questionnaire. It used a 4 point likert rating scale (1= not at all, 2= somewhat, 3=moderately so, 4= very much so). Examples of items include "I feel calm" and "I feel strained." (STAI; Spielberger, Gorsuch, & Lushene, 1970). Completion time was about 5 minutes.

Infant measures.

Infant behavior questionnaire (IBQ). The IBQ was given to either parent to assess the infant's temperament. The questionnaire consists of 37 statements about their infant's behavior. Variables measured by this instrument include: infant activity level, distress to limitations, approach, fear, duration of orienting, vocal reactivity, sadness, perceptual sensitivity, high intensity pleasure, low intensity pleasure, cuddliness, soothability, and falling reactivity/recovery from distress rate. These variables are combined to create the following factors: surgency, which describes infants with high activity levels, high intensity pleasure seeking, and low shyness and impulsivity; negative affectivity which measures the levels of sadness, discomfort, frustration, fear, and how easy it is for the infant to be soothed; and effortful control which measures the degree to which the infant utilized inhibitory control, attentional focusing, and perceptual sensitivity. Parents are asked to circle the number that best indicates how often their baby performed that behavior during the last week. It used an 8 point likert scale (1=never, 2= very rarely, 3= less than half the time, 4= about half the time, 5= more than half the time, 6= almost always, 7= always, and NA = does not apply). The NA answer was selected if the parent did not see the baby in the situation described during the last week. Example questions include "How often during the last week did the baby enjoy being read to" and "How often during the last week did the baby startle at a sudden change in body position (e.g. when moved suddenly)." (IBQ; Rothbart, 1981). This instrument takes about 10 minutes to complete.

Ages & stages questionnaires (ASQ). The ASQ was given to either parent to assess infant developmental milestones. The questionnaire consists of questions regarding

activities that babies may do. Parents are asked to fill in the circle that indicates whether their baby is doing the activity regularly, (yes), (sometimes), or (not yet). The questionnaire is divided into 6 sections [Communication, Gross Motor, Fine Motor, Problem Solving, and Personal-Social], as well as a section for open responses regarding the infant's development. Example questions include "Does your baby watch his hands" and "Does your baby use both hands and legs equally well, if no, explain." (ASQ III, 1995). The questionnaire is used to identify children who may be at risk for social and emotional difficulties. Completion time was approximately 15 minutes for all 30 questions.

Infant feeding scale. The Infant Feeding Scale was given to either parent to assess the infant's feeding habits. The questionnaire consists of 24 questions answered using a 6 point likert scale (0=never, 1= rarely, 2= occasionally, 3=frequently, 4= very frequently, 5= almost always). Example questions include "turn head away from food/shake head no" and "swallow in gulps". The questionnaire also consists of 5 "yes or no" questions such as "cry/cough/gag at the sight of a food/bottle" and "eat with a slow place." Parents had to identify how often their child was difficult to feed with the following answer options (less than 25% of the time, between 25% and 50% of the time, between 51% and 75% of the time, and more than 75% of the time (Arts-Rodas & Benoit 1998). The questionnaire took approximately 15 minutes to complete. (See Appendix B).

Infant sleep questionnaire. The Infant Sleep Questionnaire consists of 9 questions that assess difficulties with the infant sleeping. Examples of questions include "how does your baby fall asleep" and do you consider your child's sleep as a problem". Parents were asked to fill in the blank with the approximate length of time (in hours and

minutes) that it took their infant to fall asleep, as well as the average amount of time their infant slept uninterrupted during the night (Sadeh, 2004). The questionnaire was completed in 5 minutes. (See Appendix C).

Coding for the Still Face Experiment

The author and the supervising faculty developed a coding system for the still face experiment (Appendix D). The goal was to code individual behaviors but also synchronous interactions – when both mother and infant shared experiences such as gaze, vocalization, emotion, and movement. The coding system is an adaptation of the Infant Regulatory Scoring System (IRSS; Tronick & Weinberg, 1996) and the Maternal Regulatory Scoring System (MRSS; Tronick & Weinberg, 1998). For the purposes of this study, the infant gesture codes of *two hand reach* and *one hand reach* were combined into a new code we created called *reach*. We also combined infant codes that assessed attempts to distance the self from the mother in one code called *distance*. The above combinations were done to ensure that this coding system was developmentally appropriate for the motor skills of a three-month-old infant. Tronick and Weinberg's *stereotypic/odd gestures* code was not included in this coding system as it was not relevant to the research question. Additionally, all of the infant's oral codes were combined to focus on *self-comfort* mechanisms at a broader level. Lastly, we combined all infant autonomic indicators in one code because we expected infrequent occurrences due to the small sample size.

For the purpose of this study it was not necessary to differentiate between maternal *engagement* and *glances*. Therefore, all of the glance codes (*social attend glance, avert game glance*, and *object attend glance*) were excluded. Additionally, *vocalization* codes were simplified and included only positive comment about infant, positive comment about self, negative comment about infant, negative comment about self, directs to self, mouth noise, and

sings. All other vocalization codes were excluded, as we were interested in the frequency with which mothers vocalized and less interested in the specific types of vocalizations. Lastly, some of the *touch* codes were combined in order to further simplify the coding system. Specifically, the code *poke/jab* was combined with *pinch/suck on infant.*

Coding was performed using a Mangold Software program. The coder watched the video segments twice to code the infant and mother reactions separately. Codes were assigned every 1 second. Mutually exclusive codes for the infants included gaze codes, vocalization codes, gesture codes, self-comfort codes, distance codes, and autonomic indicators codes. Mutually exclusive codes for the mother included proximity to infant codes, social engagement codes, object engagement codes, avert codes, vocalization codes, caregiving codes, touch codes, and elicit codes.

Results

Concurrent and Longitudinal Correlations of Maternal and Paternal Depression Scores

In order to investigate the association between prenatal depression and postnatal depression, we conducted correlational analyses. Maternal prenatal EPDS depression scores correlated with prenatal CES-D depression scores, r =.73, p < .001, as well as with their 3 month CES-D depression scores, r = .51, p = .01. We also found a significant correlation between mother's prenatal and postnatal CES-D depression scores, r =. 53, p =. 006. Additionally, mothers with high anxiety scores on the STAI prenatally also had higher depression scores postnatally (see Table 2). A significant correlation was also found for fathers' prenatal and postnatal CES-D depression scores, r =. 67, p <. 001. Consistent with our hypothesis, mothers and fathers with higher depression scores prenatally also had higher depression scores at 3 months postpartum. In addition, in order to examine whether there was a change in the parental

depression scores over time we ran a dependent t-test analysis. There was no significant difference in depression scores for mothers, t = -1.02, p =. 32, or fathers t = -1.51, p =. 14.

Next, we wanted to determine the relationship between maternal and paternal depression scores prenatally and at 3 months. Maternal prenatal depression scores on the EPDS marginally predicted prenatal paternal depression scores on the CES-D, r =.37, p =.06. There was no significant correlation between mothers' prenatal CES-D scores and fathers' prenatal CES-D scores. Additionally, mothers' 3 month CES-D depression scores marginally related to fathers' 3 month CES-D scores, r =.38, p = .06.

Intercorrelations between Infant Outcomes

Correlations between sleep variables and other outcomes were conducted to assess how different aspects of development may relate to each other. The more hours the infant slept during the night the better their fine motor skills, r = .43, p = .03**,** problem solving skills, r =.43, p = .03**,** and personal-social skills, r =.51, p =.01**,** were. Further, the more minutes the infant spent awake during the night the better their personal-social skills were, r =.47, p=. 02. Similarly, the more minutes the infant spent awake during the night the greater their weight was at 3 months of age, r =.41, p = .04 (Table 3)**.**

Associations between Parental Depression, Anxiety, Infant Outcomes, and Interactional Synchrony

In order to determine the relationship between parental depression and infant outcomes a series of correlational analyses were conducted between scores of maternal depression and anxiety, as well as paternal depression and the following indices of infant development: sleep patterns, eating patterns, communication skills, gross motor skills, fine motor skills, problem solving skills, and personal social skills. The weight and height of infants were also included in

the analyses as an index of developmental growth. Lastly, the author focused only on the correlations between parental depression and the interactional synchrony variables because conducting so many correlational analyses with the still face variables may lead to unreliable results.

Maternal depression scores at 3 months on the CES-D were negatively correlated with the baby's sleep in hours per night, r = -.41, p = .04. The higher the mother's depression scores at 3 months, the fewer hours per night the babies slept (Table 4). Additionally, maternal 3 month depression scores on the CES-D, r = .39, p = .05 positively related to the amount of time it took for the baby to fall asleep at night, indicating that the higher the depression scores were, the longer it took the infant to fall asleep in the night (Table 4). Additionally, higher maternal depression scores at 3 months were positively correlated with infant weight at 3 months, suggesting that mothers with higher depressive symptoms at 3 months had babies who weighed more at 3 months of age (r = .46, p = .02). In regards to developmental milestones, maternal CES-D depression scores marginally predicted lower communication, r =-.36, p =.06. Paternal concurrent depression, however, significantly predicted lower communication scores at 3 months as well, r =-.39, p =.05 (Table 4).

Additional trends in the data included that fathers' 3-month depression scores were negatively related to infant gross motor skills, r =-.33, p = .09. Mothers' 3 month depression scores were also negatively related to infant fine motor skills at 3 months, r =-.37, p = .06. Thus, the greater the parental depression at 3 months the fewer gross and fine motor skills the baby had (Table 4).

Further analysis revealed that mothers' prenatal CES-D, r = .52, p = .01, and EPDS scores, r =.38, p = .057 also positively related to the amount of time it took for the baby to fall

asleep at night, indicating that the higher the mother's prenatal depression scores were, the longer it took the infant to fall asleep in the night (Table 5). Higher prenatal depression scores in the mother were negatively correlated with the number of hours per night that the baby slept, r =-.38, p = .05; r = -.52, p = .01, showing that higher maternal depression scores prenatally were associated with fewer hours of sleep per night in their babies at 3 months (Table 5).

Correlational analyses were also run to better understand the relationship between parental depression and infant eating patterns. Mothers' EPDS depression scores, r = .60, p < .001, marginally predicted feeding difficulties at 3 months. Maternal prenatal CES-D depression scores, r = .39, p = .04, significantly predicted difficulty feeding their babies at 3 months Additionally, higher prenatal state anxiety scores, r =.48, p = .01, and trait anxiety, r = .43, p = .03, significantly correlated with negative eating behaviors at 3 months. These findings suggest that mothers with higher levels of anxiety perceived their babies to be more difficult to feed at 3 months (Table 5).

Additional correlational analyses revealed that infants' ability to achieve developmental outcomes was negatively related to parental depression. Specifically, maternal prenatal EPDS depression scores and anxiety scores predicted lower communication skills at 3 months, r = -.46, p = .02 and r = -.45, p = .02, respectively. Thus, the greater prenatal depression and anxiety predicted fewer infant communication skills at 3 months (Table 5). Lastly, in terms of infant physical development, prenatal maternal depression and anxiety scores positively correlated to infant weight gain at 3 months, indicating that the higher the depression and anxiety scores the heavier the infants were at 3 months (Table 5). Consistent with our hypothesis, parental depression negatively related to various aspects of infant development including infant communication skills, gross motor skills, and fine motor skills at 3 months.

Finally, correlational analyses were run in order to examine the relationship between interactional synchrony and maternal depression. There was a significant positive correlation between maternal depression at 3 months and object attend, $r = .49$, $p = .01$, meaning that mothers with higher depression scores experienced more interactional synchrony with theirs infants when they both looked at objects (Table 4). Additionally, mothers prenatal state anxiety was also positively correlated with object attend during infant-mother interactions (Table 5).

Temperament, Depression, Infant Outcomes, Interactional Synchrony

To address the hypothesis that temperament may play a mediating role between depression and infant outcomes we first conducted correlational analyses between depression and temperament variables (surgency, negative affect, effortful control). As expected, there was a significant positive correlation between prenatal and postnatal depression and negative affect, $r = .51$, $p = .01$ and $r = .44$, $p = .02$, respectively. The higher the depression scores the more likely the mothers were to perceive their babies as having a negative affect. Because negative affect was the only variable that correlated with depression, we only focused on how negative affect may be associated with infant outcomes and interactional synchrony.

As seen in Table 6, infants greater in negative affect spent more minutes awake during the night ($r = .49$, $p = .01$). Additionally, mothers perceived them as more difficult to feed, $r = .53$, $p = .01$), although these babies were more likely weigh more at 3 months, $r = .43$, $p = .03$**.** Lastly, there was a significant positive correlation between negative affect and object attend, $r = .38$. $p = .059$, indicating that mothers who perceived their infants to be higher in negative affect tended to match their infants when attending to objects**.**

One of the goals of this study was to investigate the role of temperament in the relationship between parental depression and infant outcomes. There were two variables that

correlated with both negative affect and maternal depression at 3 months: infant weight and synchronous object attend during the still face experiment. Following Judd and Kenny's (1981) approach, we ran a series of regressional analyses to test for mediation, but the suggested model was not significant for either infant weight or synchronous object attend. We then ran linear stepwise regression analyses to find out whether negative affect or parental depression is a better predictor. As seen in Table 7, only parental depression was a significant predictor, explaining 20% of the variance in infant weight and 24% of the variance in synchronous object attend during the still face experiment.

Differences between High and Low Risk Infants

In order to better understand how depression may influence infant development, a risk index was created based on maternal and paternal depression scores prenatally and postnatally. All together there are five measurements. A score of "1" or a "0" was given to each measurement if the score was above or below what would be considered clinically high depression. The sum of the scores was then taken to create the risk index. For the CES-D, a "1" was given for any score of 16 and above and a"0" was given for all scores below a 16. For the EPDS, a "1" was given for all scores of 10 and above, and a "0" was given for all scores below a 10. We used the average of the sum of risk ($M = 2$) as a cut off to create two groups. Therefore, infants with a combined depression risk index above a 2 were classified as "high risk" and all infants with a combined depression risk index of 2 and below were classified as "low risk." Additionally, either one or both parents must have had clinically significant levels of depression at the 3-month period to be included in the high-risk group. We then conducted a series of independent sample t-tests to discern differences in infant outcomes and interactional synchrony due to risk created by parental depression.

Differences in Infant Outcomes

Independent samples t-tests were conducted to examine the means between parental depression and the following infant outcomes: sleep variables, feeding variables, developmental milestones, temperament, weight, and height. Infants classified as high risk took significantly longer to fall asleep at night (M = 81.00, SD = 82.83) than low risk infants (M = 24.19, SD = 13.71), $t(24) = -2.72$, p = .01. Mothers with higher levels of depression were also significantly more likely to perceive their baby as having a negative affect (M = 4.34, SD = 1.08) than were mothers with lower levels of depression (M = 3.52, SD = .82), $t(24) = -2.18$, p = .04. Lastly, high risk infants weighed significantly more (M= 14.35, SD= 2.07) than low risk infants did (M= 13.06, SD= 1.59), $t(23) = -1.76$, p = .09 (Table 8).

A chi-square analysis was performed to examine the relation between depression and perceiving infant sleep to be problematic. The difference was significant, X^2 (1, N= 26) = 4.63, p <. 05. More of the high risk infants were perceived as having problems with their sleep than low risk infants were.

Differences in Early Interactions

Independent samples t-tests were conducted to examine the means between interactional variables of both infants and mothers of high and low risk during the still face experiment. The following interactional variables were examined for the infants in the play phase, still face phase, and reunion phase: gaze aversion, positive and negative vocalizations, gestures, autonomic indicators of distress, self comfort, look at the same object, look at adult, look at a new object, distance, and smiles. Low risk infants engaged in significantly more self-comforting behaviors during the play phase (M = 33.01, SD = 29.52) than did high risk infants (M = 10.06, SD = 12.57), $t(24) = 2.32$, p =.01. Additionally, low risk infants looked at objects significantly less

during the play phase (*M* = 17.66, *SD* = 12.35) than high risk infants did (*M* = 39.48, *SD* = 22.35), *t*(24)= -3.22, *p* <.001 (Table 9).

Independent samples t-tests were conducted to examine the following maternal interactional variables: distance, closeness, touch, vocalization, elicit, avert game, social attend, avert, object attend, smile, and caregiving. Mothers with lower levels of depression had more distance between themselves and their infants during the play phase (*M* = 96.40, *SD* = 7.15) than did mothers with higher levels of depression (*M* = 85.91, *SD* = 19.47), *t*(24)= 1.97, *p* = .06. It follows then, that mothers with higher levels of depression were closer in physical proximity to their infants during the play phase (*M*= 14.72, *SD* = 19.36) than were mothers with lower levels of depression (*M* = 4.01, *SD* = 7.18), *t*(24)= -2.02, *p* = .05. Additionally, mothers with higher levels of depression made significantly more vocalizations (*M* = 82.15, *SD* = 9.50) than mothers with lower levels of depression (*M* = 71.80, *SD* = 11.41), *t*(24)= -2.39, *p* = .03. Mothers with lower levels of depression looked at their infant significantly more during the play phase (*M* = 98.58, *SD* = 2.61) than did mothers with higher levels of depression (*M* = 93.58, *SD*= 7.14), *t*(24)= 2.57, *p* = .02. They also spent less time looking at objects (*M* = .14, *SD* = .54) than mothers with higher levels of depression (*M* = 3.46, *SD* = 7.66), *t*(24)= -1.75, *p* = .09, although this finding only approached significance (Table 10).

During the reunion phase, mothers with lower levels of depression touched their infants more (*M* = 110.39 *SD* = 41.68) than mothers with higher levels of depression (*M* = 78.13, *SD* = 48.35), *t*(23)= 1.78, *p*= .08. They also looked at objects significantly more (*M* = 1.15, *SD* = 1.21) than mothers with lower levels of depression (*M* = .12, *SD* = .31), *t*(22) = -3.07, *p* = .01 (Table 11).

Discussion

The author of this study aimed to examine the relationship between parental depression and a broad index of infant development that included developmental milestones, feeding and sleeping patterns, physical growth, and early interactional patterns in the infant-mother dyad. Another goal of the author was to investigate the role of infant temperament in how parental depression relates to infant outcomes. The author hypothesized that infants of depressed parents would have a slower growth rate that would show in more feeding difficulties and sleep disturbances, as well as delayed developmental milestones and lower weight at 3 months of age. The author predicted that these negative consequences would be heightened in infants who had both a mother and a father experiencing depression at the 3-month postpartum mark. In regards to early interactional patterns in the infant-mother dyad, the author hypothesized that infants of depressed mothers would have a faster decline in gazing at the mother during the still face experiment and engage in fewer vocalizations than infants of nondepressed mothers. Lastly, the author was interested in exploring if depressed mothers and fathers played different roles in contributing to the healthy growth and development of their infant.

Parental Depression and Indices of Infant Development

Consistent with the author's expectation, maternal depression scores at 3 months postpartum were negatively associated with the baby's sleep in hours per night. Further analysis revealed that mothers' depression was both concurrently and longitudinally related to infant sleep disturbances, as both mothers' prenatal and postnatal CES-D depression scores positively related to the amount of time it took for the baby to fall asleep at night, indicating that the higher the depression scores were, the longer it took infants to fall asleep in the night. Lastly, mothers' prenatal depression scores were negatively related to the amount of hours their infant slept

during the night. Thus, as predicted, infants of depressed parents displayed more sleep difficulties, including taking a longer amount of time for the baby to fall asleep at night and sleeping fewer hours when compared to infants of nondepressed parents. These findings are consistent with previous research that has suggested that 12-month old infants with depressed mothers showed greater than two of the following dysfunctional sleep patterns: sleeping less than 12 hours a night, frequent nighttime awakenings, absence of a sleep routine, and night terrors (Pinheiro et al., 2011).

Contrary to the author's prediction, infants of depressed parents did not weigh less than infants of nondepressed parents at 3 months postpartum. In fact, high risk infants weighed significantly more than low risk infants in the present study. One possible explanation for this could be that since infants of depressed mothers take longer to fall asleep and wake up more frequently during the night, infants of depressed mothers are fed more frequently. For example, when the infant wakes up in the night, the mother might feed their baby in an effort to get the infant back to sleep. Because high risk infants are waking up more frequently than low risk infants do, those extra nighttime feedings are one potential explanation for their heavier weight at 3 months of age. Additionally, higher maternal state and trait anxiety scores as well as depression scores prenatally and postnatally significantly correlated with negative eating behaviors and difficulty feeding at 3 months. An alternative understanding for why infants of depressed mothers weighed more at 3 months is that anxious mothers over fed their infants due to concerns about infant weight gain. While the literature shows infants of depressed mothers typically gain less weight on average than infants of nondepressed mothers (Gress-Smith et al., 2012), this trend may be realized later than 3 months of age as infants begin to refuse eating if they are overwhelmed and pressed by their mother to eat when they are not hungry.

The author of the present study was also interested in exploring if parental depression related to infants' ability to achieve developmental milestones in communication skills, gross motor skills, fine motor skills, problem solving skills, and personal-social skills at 3 months. As predicted, infants of depressed mothers had difficulties achieving developmental milestones, specifically in the areas of communication, gross motor skills, and fine motor skills. Mothers' prenatal EPDS depression scores as well as her anxiety scores were negatively related to infant communication skills at 3 months. While maternal CES-D depression scores were only marginally related to fewer communication skills at 3 months, concurrent paternal depression was negatively associated with infant communication skills. The finding that prenatal maternal depression is negatively related to infants' ability to achieve communication milestones is consistent with the literature, which has found that maternal depression predicts significantly lower percentile scores on the infant expressive communication subscale at 12 months (Kaplan et al., 2014). Thus, the findings of the present study suggest that infants of depressed parents begin to fall behind in communication skills as early as 3 months of age.

Additionally, parental depression was negatively related to infants' gross and fine motor skills at 3 months. While infants with depressed parents had difficulties achieving developmental milestones in both fine and gross motor skills, mothers and fathers seemed to each have their own distinct role in promoting the development of their infant's motor skills. Specifically, maternal depression at 3 months was negatively related to infant fine motor skills, whereas paternal depression at 3 months was negatively related to infant gross motor skills. This makes sense when traditional family roles are considered, as fathers are typically thought to be more active with their children, playing ball, tag, and various other sports, all of which relate to gross motor skills. Paquette and Dumont's (2013) research supports this claim as they found fathers

are more likely to engage in creative and unconventional play with their children than mothers are. Further, they found that fathers tend to excite children and engage in more physical play with them than mothers do. This abundance of physical, stimulatory, play between fathers and children is one possible explanation as to why fathers' depression scores were related to infant gross motor skills at 3 months. In contrast, the traditional role of the mother is to tend to the child's activities of daily living including feeding and bathing the child, both of which encourage the development of fine motor skills.

Consistent with the literature, infants who slept more hours during the night had better fine motor skills, problem solving skills, and personal-social skills. Additionally, better personal-social skills were associated with more time spent awake during the night. This could potentially be understood as more sociable babies sleep fewer hours during the night because they are interested in people and conversing with their parents. Lastly, the more minutes the infant spent awake during the night, the greater their weight was at 3 months. Interestingly, most of these variables related to parental depression either prenatally or postnatally, implying that depression can potentially influence multiple aspects of development that seem to appear unrelated.

Early Interactional Patterns in the Mother-Infant Dyad

Ekas, Haltigan and Messinger (2012) found that 6-month-old infants of depressed mothers showed a faster decline in gazing at the mother during the still face period. The results of the present study support this finding as a comparison of means between high and low risk infants revealed that high risk infants looked at objects significantly more than infants of nondepressed mothers. This is likely a demonstration of the infant's typical day-to-day interactional pattern with their mother, as depressed mothers typically are less engaged with their infant, leaving their infant to interact with items in their environment, such as objects. Thus, the

infant's behavior in this situation is not merely a response to the primary caregiver's absence, but is determined by the history of their daily interactions in different contexts (Cohn & Tronick, 1983). Additionally, the current findings reveal that low risk infants engaged in significantly more self-comforting behaviors than high risk infants did. This suggests that infants of nondepressed mothers were not accustomed to their mothers being unresponsive to their needs, so they engaged in active coping styles to diminish their distress at their mother's lack of involvement. Feeling secure in knowing that their mother reliably attends to their needs, infants of nondepressed mothers are likely better able to utilize self-comforting skills in times of distress as they know it will only be a short time before their mother is there to comfort them. Lacking this sense of predictability of mothers' responsiveness, infants of depressed mothers do not have the capacity to engage in self comforting behaviors because they are unsure when or if their mothers will attend to their needs. This inconsistency of depressed mothers' availability likely consumes all of the infant's mental capacity, leaving them with no room to cognitively consider and engage in active coping and self comforting. This is in accordance with Teti, Gelfand, Messinger, and Isabella's (1995) finding that insecure infant attachments tend to be associated with mothers who had depression that lasted beyond the first 6 months of giving birth. The infants of the present study were only 3 months old and displayed behaviors characteristic of resistant attachment styles, as they inconsistently engaged with the caregiver and did not accept comfort, whether it was from their mother or by actively trying to comfort themselves through the use of self comforting skills (Simpson, Rholes, & Nelligan, 1992). Thus, the findings of the current study suggest that early precursors of infant attachment style can be seen as early as 3 months of age.

Current trends in the literature suggest that depressed mothers are less positive, less contingent, and engage in less vocal and play interaction during the still face experiment (Veltema et al., 2003). The findings of the present study did not support this trend in the literature, as mothers with higher levels of depression actually made significantly more vocalizations and were closer in physical proximity to their infant during the still face experiment. One possible explanation for this is that depressed mothers in the study were aware that they were being filmed during the still face experiment, so they engaged in more vocalizations in an effort to appear engaging. Additionally, depressed mothers' close physical proximity to the infant during the still face experiment could be understood as intrusive or smothering to the infant, as they again are working very hard, perhaps harder than nondepressed mothers, to appear engaged and attentive to their baby. Nondepressed mothers are able to have more physical distance between themselves and their infants because they are more relaxed and accustomed to socially engaging with their child. This finding is akin to that of Malphurs, Raag, Field, Pickens, and Pelaez-Nogueras' (1996) who reported that a greater proportion of the depressed mothers were classified as intrusive versus nondepressed mothers. Malphurs et al. found intrusive mothers to engage in more negative touch with their infants, which in turn resulted in an increase in negative infant states. Further, they found that infants of intrusive mothers spent more time in negative behavior states and less time in positive states (Malphurs et al., 1996). It is likely that with a larger sample size the present study would have found the same trend.

Mothers with lower levels of depression responded differently during the still face experiment than mothers higher in depression. First, they spent significantly less time looking at objects and more time looking at their infant. They also touched their infants significantly more

during the reunion phase, perhaps in an attempt to physically comfort their distressed infant. These findings are consistent with recent trends in the literature that state nondepressed mothers touch their infants more frequently, and infants were less distressed when their mothers touched them during the still face experiment (Lyons-Ruth, Zoll, Connell, & Grunebaum, 1986).

An additional goal of the present study was to examine interactional synchrony between the infant-mother dyad. While the differences in the variables of interactional synchrony were not all significant, it is important to note that all of the differences were trending in the expected direction. For example, the low risk group of infants and their mothers experienced more synchrony when gazing and smiling at each other than the high risk group did. By contrast, however, infants and mothers classified as high risk did have significantly more instances of matching when they were attending to objects. These findings have serious implications for the infant-mother relationship because by engaging in significantly more synchronous attention to objects, depressed mothers are teaching their infants from a very young age to be oriented towards objects as opposed to people. Thus, future studies should investigate the impact of such early orientation towards objects in relationship to infant personal-social skills as infants continue to grow and develop.

Temperament, Depression, and Infant Outcomes

When investigating infant temperament, maternal depression scores both prenatally and at 3 months correlated with infant negative affect. Specifically, the higher the mother's prenatal and postnatal CES-D depression scores, the more likely they were to perceive their baby as having a negative affect. Thus, consistent with the author's hypothesis, depressed parents can potentially perceive their infants in a negative way and consequently influence the quality of their caregiving. The temperamental dimension of negative affect was related with the following

infant outcomes: sleep, feeding, and weight. Infants greater in negative affect spent more minutes awake during the night, and while they were perceived as being more difficult to feed, they actually weighed more at 3 months. This is consistent with the literature, which has found that infant affect might be most negatively affected by intrusive styles of interaction in the mother-infant dyad (Malphurs et. al, 1996). The fact that depressed mothers in the present study perceived their infants to be higher in negative affect then, could be related to their overall intrusive nature, as they over feed their infants, are closer in physical proximity, and overstimulate their babies with more frequent vocalizations. Thus, despite maternal perceptions that infants with negative affect are harder to feed, they actually weigh more at 3 months due to the intrusiveness of their mother, which may lead to overfeeding.

Often times, temperament appears to have a mediating role in a relationship between two variables in that it fully or partially explains their link (Sroufe, Egeland, Carlson, Collins, 2005). The mediating analyses did not support that temperament mediated the relationship between maternal depression and infant weight and between maternal depression and synchronous object attend. Instead, when negative affect and maternal depression were considered as independent predictors only maternal depression explained variance in infant weight and synchronous object orientation which highlights the potential influence of depression regardless of the child's temperament. However, a larger sample could potentially allow the detection of mediating effects.

The Relationship between Maternal and Paternal Depression Scores

Very few studies have examined the course of maternal and paternal depression during the transition to parenthood. The present findings suggest that prenatal maternal depression remains stable 3 months after having the baby. The same is true for fathers, as those fathers with

higher depression scores in the prenatal period also had higher depression scores postnatally. Contrary to the author's prediction, there was no significant relationship between maternal and paternal depression. While fathers experience hormonal changes and may be at risk of postpartum depression (Klotter, 2012) it appears that mothers with depression seek out partners who are not depressed. These results suggest that while maternal depression has repeatedly been shown to negatively relate to various aspects of infant development, fathers who are not depressed may still be available to attend to their infant, and if supported, can expose their infant to positive affect, infant directed speech, and symbolic play, all of which are important areas of growth and development (Sohr-Preston & Scaramella, 2006).

Limitations and Future Directions

This is the first study that utilizes multiple indices of infant development, considers both maternal and paternal depression, and explored the role of temperament in the relationship between parental depression and infant outcomes. Despite the significant contributions of the findings, many of the results, while trending in the expected directions, were not significant. This was due to the small sample size that resulted in lower statistical power. Thus, future research of parental depression and infant outcomes should utilize a larger sample size in order to detect significant associations. A larger sample should also include greater variability in race, ethnicity, and socioeconomic status (SES). Such demographic change could potentially result in additional negative correlations between parental depression and infant outcomes given the added risk factors and stressors associated with lower socioeconomic status. For example, Leigh and Milgrom (2008) found that the impact of parental depression on child development is modest in high economic samples. Thus, low socioeconomic status as a risk factor could alter the amount of availability and sensitivity parents have to support and promote healthy infant development

(Leigh & Milgrom, 2008). Morevoer, a greater sample would have allowed the exploration of gender as a factor moderating the relationship between parental depression and infant development, particularly in terms of whether infants develop an object- or person-orientation.

Another limitation of the present study is the relatively high number of correlational and t-test analyses that were run. This could potentially have resulted in significant results by chance. Consolidating the variables would have decreased the number of analyses. For example, several variables from the still face could have been combined to create a social competence variable.

An additional limitation was the lack of breadth in depression levels in the present study. Thus, even those infants who were categorized as "high risk" did not have parents with severe, debilitating, clinical depression. Leigh and Milgrom (2008) found infant outcomes were more negatively related to parental depression when the postnatal depression was chronic and severe. Future studies should investigate the relationship between parental depression and infant outcomes with a population with various levels of depressive symptoms in order to better understand how severe depression relates to various indices of infant development.

Another limitation of the study is the likelihood that parents responded to questionnaires in socially desirable ways. Moreover, it is likely that many parents, especially those with depression, knew that they were being observed for their interactional patterns during the still face experiment and tried to compensate for their depression. Future studies should perhaps have a double blind design in order to diminish the likelihood of social desirability. Lastly, the current sample included married or cohabitating parents only. Future studies should consider exploring the impact of parental depression on infant outcomes when the parents are single, divorced, separated, or non-cohabitating.

Future research on the relationship between parental depression and infant outcomes should employ a longitudinal design similar to this study, but one that encompasses a longer period of time. While it is important to study families before the baby is born, it is also informative to follow them for an extensive period of time. For example, it would be important to note how infants are or are not achieving developmental milestones at 6 months, 12 months, and 18 months of age. A longitudinal design would allow for more conclusive evidence of how parental depression relates to attachment and other social interactions. Of specific interest would be to investigate how the early object-orientation shapes social relationships of children in the preschool period. A similar question is to how stable the infant-mother interactional patterns are across time and how they are influenced by maternal perceptions of negative affectivity. Pinpointing the role of fathers is illusive in the early months of child development but it is possible that depressed fathers have a more direct role in relating to child development later on.

Additionally, future research could also examine the method of feeding (breastfeeding vs. formula) in relation to parental depression and infant weight at 3 months. Santos, Matijasevich, and Domingues (2012) found that a higher prevalence of nighttime wakings in infancy has been associated with exclusive breastfeeding. Thus, future research should explore whether babies who are breastfeed wake up more frequently, resulting in more frequent feedings, and whether or not this pattern is intensified when the mothers are depressed. Another extension of the present study would be to include fathers in the still face procedure to confirm the early object orientation in the father-infant interaction when fathers are depressed. Lastly, future research could explore how infant sleep difficulties influence the mother's own sleep patterns, and how that in turn, could influence how she perceives the baby's overall temperament, specifically

negative affect. The aforementioned questions are all suggestions for future research that would build and expand upon the findings of the present study.

Conclusions

The results of this study support the fact that parental depression is negatively related to various indices of infant development, particularly infant feeding and sleep patterns as well as infant weight gain. More specifically, infants with depressed parents were perceived to be more difficult to feed, weighed more at 3 months postpartum, and had more disrupted sleep patterns. In terms of developmental milestones, infants with depressed parents struggled to achieve expected skill levels in the areas of communication, gross motor skills, and fine motor skills. Specifically, maternal depression negatively related to infant fine motor and communication skills at 3 months, while paternal depression negatively related to infant gross motor skill development. Differences were also found between interactional patterns in the mother-infant dyad between infants of depressed and nondepressed mothers. Specifically, infants of depressed mothers looked at objects more frequently and showed differences in patterns of gaze aversion. Lastly, when engaging in synchronous interactions, depressed mothers and their infants tend to focus more on other objects instead of each other.

While paternal depression was associated with some infant outcomes, maternal depression overwhelmingly appeared to be a better predictor of infant development during the first 3 months of life. Stability in depression was remarkable even though the trend was for only one of the two spouses to experience depression. This appears to create a protective factor for the infants. Lastly, although temperament and depression correlated, depression seems to have a stronger predictive value of infant development.

The current findings support and extend previous literature by considering multiple indices of infant development, including paternal depression, and examining their associations longitudinally during the transition to parenthood

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders.* (5th ed. text rev).

Cohn, J.F., & Tronick, E.Z. (1983). Three-month-old-infants' reaction to simulated maternal depression. *Journal of Child Development, 54,* 185-193.

Cohn, J.F., Campbell, S.B., Ross, S. (1991) Infant response in the still-face paradigm at 6 months predicts avoidant and secure attachment at 12 months. *Development and Psychopathology, 3,* 367-376.

Conradt, E., & Ablot, J.(2010). Infant physiological response to the still-face paradigm: Contributions of maternal sensitivity and infants' early regulatory behaviors. *Infant Behavior and Development, 33,* 251-265.

DelRosario, G. A., Chang, A. C., & Lee, E. D. (2013). Postpartum depression: symptoms, diagnosis, and treatment approaches. *Journal of the American Academy of Physician Assistants, 26*(2), 50-54.

Dennis, C.L., & McQueen, K. (2007). Does maternal postpartum depressive symptomology influence infant feeding outcomes? *Acta Paediatrica, 96,* 590-594.

Ekas, N.V., Haltigan, J.D., & Messinger, D.S. (2013). The dynamic still-face effect: do infants decrease bidding over time when parents are not responsive? *Journal of Developmental Psychology, 49*(6), 1027-1035. doi: 10.1037/a0029330.

Field, M.T. (2010). Postpartum depression effects on early interactions, parenting, and safety practices: A review. *Infant Behavior & Development, 33,* 1-6. doi: 10.1016/j.infbeh.2009.10.005

Field, M.T. (2002). Early interactions between infants and their postpartum depressed mothers. *Infant Behavior & Development 25,* 25-29.

Gress-Smith, L.J., Luecken, J.L., Lemery-Chalfant, K., & Howe, R.(2012). Postpartum depression prevalence and impact on infant health, weight, and sleep in low-income and ethnic minority women and infants. *Journal of Maternal Child Health (16)* 887-893. doi: 10.1007/s10995-011-0812-y

Hack, M., Klein, N.K., Taylor, H.G. (1995). Long term and developmental outcomes of low birth weight infants. *The Future of Children 5,*(1), 176-196. doi:10.2307/1602514

Hendrick, V., Altshuler, L.L., Suri, R. (1998). Hormonal changes in the postpartum and implications for postpartum depression. *Psychosomatics 39,* 93-101.

Hill-Soderlund, A.L., & Braumgart-Rieker, J.M. (2008). Early individual differences in temperamental reactivity and regulation: Implications for effortful control in early childhood. *Journal of Infant Behavior and Development. 31*(3), 386-397. doi: 10.1016/j.infbeh.2007.12.007

Judd, C. M. & Kenny, D. A. (1981). Process analysis: estimating mediation in treatment evaluations, *Evaluation Review, 5(5)* 602-619.

Kaplan, S.P., Danko, M. C., Everhart, D.K., Diaz, A., Asherin, M.R., Vogeli, M.J., & Fekri, M.S. (2014). Maternal depression and expressive communication in one year-old infants. *Journal of Infant Behavior and Development 37,* 398-405.

Klotter, J. (2012). Fatherhood and hormones. *Townsend Letter , 348,* 20. Retrieved from http://libraries.state.ma.us.com

Leigh, B., & Milgrom, J.(2008). Risk factors for antenatal depression, postnatal depression and parenting stress. *BioMed (BMC) Central Psychiatry*, 8-24. doi: 10.1186/1471-244X-8-24.

Lyons-Ruth, K., Zoll, D., Connell, D., & Grunebaum, H. (1986). The depressed mother and her one-year-old infant: environment, interaction, attachment and infant development. In E. Tronick and T. Field (Eds), *Maternal Depression and Infant Disturbance*. New York: Jossey-Bass, 61-83.

Montirosso, R., Fedeli, C., Murray, L., Morandi, F., Brusati, R., Perego, G.G., & Borgatti, R. (2011) The role of negative maternal affective states and infant temperament in early interactions between infants with cleft lip and their mothers. *Journal of Pediatric Psychology,* 241-250.

O'Hara, M.W.(2009). Postpartum depression: what we know. *Journal of Clinical Psychology, 65*(12), 1258-1269. doi: 10.1002/jclp.20644

Paquette, D., & Dumont, C.(2013). The father-child activation relationship, sex differences, and attachment disorganization in toddlerhood. *Child Development Research,* 1-9. doi: 10.1155/2013/102860.

Pinheiro, K.A.T., Pinheiro, R.T., Azevedo da Silva, R., Monteiro da Cunha, F., de Avila Quevedo, L., Vanila Godoy, R., Jansen, K., Lessa Horta, B., & Oses, J.P.(2010). Chronicity and severity of maternal postpartum depression and infant sleep disorders: A population-based cohort study in southern Brazil. *Journal of Infant Behavior and Development 34,* 371-373.

Reite, M., Short, R., Seller, C., & Pauly J.D. (1981). Attachment, loss, and depression. *Journal of Child Psychology and Psychiatry, 22,* 141-169.

Rothbart, M.K., Ahadi, S.A., & Evans, D.E. (2000). Temperament and personality: Origins and outcomes. *Journal of Personality and Social Psychology. 78*(1), 122-135. doi:10.1037//0022-3514.78.1.122

Santos, I.S., Matijasevich, A., & Domingues, R. (2012). Maternal caffeine consumption and infant nighttime waking: Prospective cohort study. *Pediatrics* 129(5), 860-868. doi: 10.1542/peds.2011-1773.

Segre, S.L., Davis, N.W. (2013). Postpartum depression and perinatal mood disorders in the DSM. *Postpartum Support International*. June, 2013.

Simpson, A.J., Rholes, S.W., Nelligan, S.J.(1992). Support seeking and support in an anxiety provoking situation: The role of attachment styles. *Journal of Personality and Social Psychology, 62*(3), 434-446.

Skalkidou, A., Hellgren, C., Comasco, E., Sylven, S., & Poroma, I.S.(2012). Biological aspects of postpartum depression. *Women's Health, 8.6,* p.659.

Sohr-Preston, L.S., Scaramella, V.L. (2006). Implications of timing of maternal depressive symptoms for early cognitive and language development. *Clinical Child and Family Psychology Review (9)* 65-83. doi:10.1007/s10567-006-0004-2.

Sroufe, L. A., Egeland, B., Carlson, E. A., & Collins, W. A. (2005). *The development of the person: The Minnesota study of risk and adaptation from birth to adulthood.* New York, NY: Guilford Press.

Teti, M.D., Gelfand, M.D., Messinger, S.D., Isabella, R. (1995). Maternal depression and the quality of early attachment: An examination of infants, preschoolers, and their mothers. *Developmental Psychology 31*(3), 364-376.

Veltema, M.R., Perrreard, E.C., Bousquet, A., & Manzano, J. (2002). Postpartum depression and mother-infant relationship at 3 months old. *Journal of Affective Disorders 70* (3), 291-306. doi:10.1016/S0165-0327(01)00367-6

Veltema, M.R., Bousquet, A., Manzano, J.(2003). Impact of postpartum depressive symptoms on mother and her 18 month old infant. *European Child & Adolescent Psychiatry. 12,* 75-83. doi: 10.1007/s00787-003-0311-

Table 1

Demographic Information

Characteristic	Mother (N=26)	Father (N=26)	Couples (N=26)	Mean (N=26)
Education level completed				
H.S. Diploma/G.E.D.	12.0	16.7		
Associate/Vocational Degree	4.0	4.2		
Bachelor's Degree	16.0	25.0		
Graduate Degree	68.0	54.2		
Ethnicity				
White	88.0	88.0		
African American	0.0	4.0		
Hispanic	8.0	4.0		
Native American	4.0	4.0		
Employment Status				
Not Employed	8.0	4.0		
Employed 35 hours +	64.0	88.0		
Employed 35 hours -	20.0	4.0		
Other	8.0	4.0		
Previous Marriages				
Previous Marriage	16.0	16.7		
No Previous Marriages	84.0	83.3		
Current Relationship				
Married			80.0	
Not Married, Living Together			20.0	
Estimated Yearly Income				
8,001-15,000			4.0	
25,001-35,00			4.0	
35,001-45,000			8.0	
55,001 and over			84.0	
Child Care Arrangement				
Family Member			50.0	
Daycare Center			33.3	
Multiple Arrangements			16.7	
Prenatal Visit Data				
Mom's Age in Years				31.48
Dad's Age in Years				34.04
Years Married As A Couple				2.98
Years Together As A Couple				3.36

Table 2

Correlations between Maternal and Paternal Depression Scores Prenatally and at 3 months

	(STAI) State Anxiety	(STAI) Trait Anxiety	Prenatal EPDS Mother	Prenatal CES-D Mother	Prenatal CES-D Father	3 Month CES-D Mother	3 Month CES-D Father
(STAI) State Anxiety	-	**.74****	**.84****	**.82****	.29	**.49****	.06
(STAI) Trait Anxiety		-	**.80****	**.84****	.30	**.45***	.05
Prenatal Maternal EPDS			-	**.73****	.37	**.53***	.07
Prenatal CES-D Mother				-	.23	**.53****	.07
Prenatal CES-D Father					-	.27	**.67****
3 Month CES-D Mother						-	.38
3 Month CES-D Father							-

Note. N= 26 for all analyses; *p<.05; **p<.01

Table 3

Intercorrelations Between Infant Sleep, Developmental Outcomes, Eating Difficulty, and Weight at 3 Months

Infant Outcomes	ASQ Communication	ASQ Gross Motor	ASQ Fine Motor	ASQ Problem Solving	ASQ Personal Social	Eating Difficulty	Weight at 3 Months
Sleep in hours during the day	.16	-.07	.12	-.03	-.08	.19	-.09
Sleep in hours at night	.25	.30	**.43***	**.43***	**.51****	-.08	.32
Average number of wakings per night	-.03	.36	.33	.17	.30	.04	.16
Wakefulness in minutes	.10	.15	-.03	.31	**.47***	.35	**.41***
Take for baby to sleep in minutes	-.24	.07	.02	-.01	.19	.13	.24
Is child's sleep a problem	-.01	-.10	-.07	.14	.04	.19	.00

Note. N= 26 for all analyses; *p<.05; **p<.01

Table 4

Correlations Between Infant Outcomes and Depression Scores at 3 Months

3 Month Mom CES-D	3 Month Dad CES-D	Infant Outcome
.07	.24	Number of wakings per night
-.41*	-.26	Sleep in hours
.31	-.03	Wakefulness in minutes
.39	.18	Amount of time it takes for baby to fall asleep
.24	-.12	Eating ratings
-.33	**-.39***	ASQ Communication
-.10	-.33	ASQ Gross Motor
-.37	-.11	ASQ Fine Motor
-.07	-.22	ASQ Problem Solving
-.01	-.16	ASQ Personal Social
.46*	.08	Weight at 3 Months
.21	.15	Height at 3 Months
-.17	-.24	Surgency
.44*	.30	Negative Affect
-.11	-.32	Effortful Control
		Interactional Synchrony
-.09	-.04	Mutual Gaze
-.07	.25	Smiles
.19	.31	Avert Gaze
.49*	-.06	Object Attend

Note. N=26 for all analyses; *p<.05,

Table 5

Correlations Between Infant Outcomes and Prenatal Depression

Mom's Prenatal EPDS	Mom's Prenatal CES-D	Mom's Prenatal State Anxiety	Mom's Prenatal Trait Anxiety	Dad's Prenatal CES-D	Infant Outcomes
.14	-.00	-.04	.14	.37	Number of wakings per night
-.38*	-.13	-.19	-.15	-.18	Sleep in hours
.16	.33	.16	.25	-.14	Wakefulness in minutes
.38*	**.52****	.24	**.49***	.07	Amount of time it takes for baby to fall asleep
.36	**.60****	**.48***	**.43***	-.07	Eating Difficulty
-.46*	-.36	**-.45***	**-.45***	-.21	ASQ Communication
.00	-.03	-.05	.01	-.08	ASQ Gross Motor
-.19	-.15	-.26	-.07	.19	ASQ Fine Motor
.03	.06	.02	.10	.06	ASQ Problem Solving
-.04	-.00	-.09	.04	.01	ASQ Personal Social
.47*	.40	**.50***	**.64****	.21	Weight at 3 Months
.23	.37	.39	**.47***	.35	Height at 3 Months
-.08	.03	.12	.02	-.11	Surgency
.38	**.51****	**.46***	**.41***	.09	Negative Affect
-.01	-.09	.09	-.09	-.15	Effortful Control
					Interactional Synchrony
-.10	.10	-.08	-.08	.07	Mutual Gaze
-.24	.02	-.11	-.08	.36	Smiles
.15	.20	.02	.27	-.04	Avert Gaze
.33	.34	**.43***	.39	.00	Object Attend

Note. N=26 for all analyses; *p<.05; **p<.01

Table 6

Correlations Between the Temperamental Dimension of Negative Affect and Infant Outcomes

Infant Outcomes	Negative Affect
Sleep in hours during the night	-.05
Sleep in hours during the day	-.06
Average number of wakings per night	.23
Wakefulness in minutes	**.49***
Amount of time it takes for baby to fall asleep in min.	.32
Is child's sleep a problem	-.33
ASQ Communication	-.19
ASQ Gross Motor Skills	.15
ASQ Fine Motor Skills	-.03
ASQ Problem Solving	.21
ASQ Personal Social	.22
Eating Difficulty	**.53****
Weight at 3 months	**.43***
Height at 3 months	.24
Interactional Synchrony	
Mutual Gaze	-.57
Smiles	-.03
Avert Gaze	.20
Object Attend	**.38***

Note. N= 26 for all analyses; *p<.05; **p<.01

Table 7

Summary of Stepwise Regressional Analyses

			Infant weight	
Predictors	*B*	*SE*	*β*	R^2
Maternal Depression	.44	.18	**.45***	.20
			Synchronous Object Attend	
Predictors	*B*	*SE*	*β*	R^2
Maternal Depression	.49	.18	**.49***	.24

Table 8

Differences in Infant Outcomes between High and Low Risk Infants

	Low Risk		High Risk		
Variables	*M*	*SD*	*M*	*SD*	*CI*
Temperament					
Surgency	4.16	.74	3.73	.74	[-.19, 1.04]
Negative Affect	3.52*	.82	4.34*	1.08	[-1.58, -.04]
Effortful Control	5.58	.52	5.34	.55	[-.23, .66]
ASQ					
Communication	13.75	2.86	12.70	2.31	[-1.17, 3.27]
Gross Motor	15.75	3.86	14.60	3.20	[-1.87, 4.17]
Fine Motor	13.19	3.35	12.80	3.85	[-2.56, 3.34]
Problem Solving	13.69	3.59	13.50	3.95	[-2.92, 3.29]
Personal Social	14.44	3.63	14.90	3.54	[-3.46, 2.53]
Sleep					
Sleep arrangement	2.06	1.48	2.70	1.89	[-2.01, .73]
Sleep position	2.69	.60	2.90	.74	[-.76, .33]
Sleep in min. night	523.13	99.18	480.00	169.71	[-65.19, 151.44]
Sleep in min. day	234.38	90.48	243.00	119.54	[-93.77, 76.52]
Wakings per night	1.59	1.25	2.10	1.37	[-1.59, .57]
Wakefulness	77.25	103.65	121.00	120.25	[-135.41, 47.91]
Time to fall asleep	24.19*	13.71	81.00*	82.83	[-99.96, -13.66]
How does baby fall asleep	3.94	1.91	3.50	2.07	[-1.20, 2.08]
Bed time in hours	8.28	.84	9.15	1.60	[-1.85, .12]
Is sleep a problem	2.81	.40	2.30	.67	[.08, .95]
Eating Difficulties	.99	.60	1.00	.39	[-.45, .43]
Weight	13.06*	1.59	14.35*	2.07	[-2.80, .23]
Height	24.48	1.31	25.03	.69	[-1.48, .38]

Note. N= 26 for all analyses; *p<.05;

Table 9

Differences in Maternal Reactions during the Still Face Experiment

	Low Risk		High Risk		
Interactional Variables	*M*	*SD*	*M*	*SD*	CI
Play					
Distance	**96.40***	7.15	**85.91***	19.47	[-.49, 21.48]
Closeness	**4.01***	7.18	**14.72***	19.36	[-21.64, .24]
Touch	105.49	47.61	102.64	30.94	[-32.21, 37.91]
Vocalization	**71.80***	11.41	**82.15***	9.50	[-19.28, -1.42]
Elicit	7.85	11.09	15.19	15.27	[-18.00, 3.33]
Avert Game	.56	1.67	1.72	2.87	[-3.03, .72]
Social Attend	**98.58***	2.61	**93.58***	7.14	[.99, 9.03]
Avert	.77	1.50	1.93	3.01	[-2.99, .66]
Object Attend	**.14***	.54	**3.46***	7.66	[-7.24, .60]
Smile	32.78	23.93	35.56	21.78	[-22.03, 16.48]
Caregiving	3.61	3.68	2.26	2.06	[-1.29, 3.99]
Reunion					
Distance	81.30	31.99	71.19	31.27	[31.99, 8.26]
Closeness	17.78	30.58	19.09	24.13	[-25.15, 22.53]
Touch	**110.39***	41.68	**78.13***	48.35	[-5.24, 69.77]
Vocalization	69.53	12.66	69.56	23.03	[-14.78, 14.72]
Elicit	6.60	10.22	15.23	23.31	[-22.71, 5.36]
Avert Game	13.33	34.96	10.09	31.02	[-25.03, 31.51]
Social Attend	86.09	33.34	73.80	35.62	[-16.64, 41.21]
Avert	2.49	4.92	4.84	9.41	[-8.28, 3.59]
Object Attend	**.12***	.31	**1.15***	1.21	[-1.73, -.33]
Smile	27.14	19.16	31.20	24.03	[-21.96, 13.85]
Caregiving	3.83	3.91	4.25	8.99	[-5.83, 4.97]

Note. N=26 for all analyses; *p<.05, **p<.01

Table 10 *Differences in Infant Reactions During the Still Face Experiment*

	Low Risk		High Risk		
Interactional Variables	*M*	*SD*	*M*	*SD*	*CI*
Play					
Gaze Aversion	22.38	18.29	15.25	10.97	[-6.14, 20.39]
Negative Vocalization	12.45	13.85	7.42	8.73	[-5.10, 15.17
Positive Vocalization	10.90	10.00	8.95	13.12	[-7.43,11.33]
Gestures	12.12	12.68	11.28	17.63	[-11.42, 13.09]
Autonomic	2.62	5.12	1.08	2.10	[-1.99, 5.07]
Self Comfort	**33.01***	29.52	**10.06***	12.57	[2.51, 43.40]
Look at object	**17.66***	12.35	**39.48****	22.35	[-35.81, -7.84]
Look at adult	53.78	26.59	38.90	21.45	[-5.74, 35.51]
Look at new object	6.30	5.03	6.06	2.69	[-3.35, 3.81]
Distance	2.30	5.27	1.03	1.55	[-2.28, 4.83]
Smile	12.93	17.92	9.03	13.56	[-9.77,17.56]
Still Face					
Gaze Aversion	47.82	30.36	56.91	29.94	[-34.22, 16.04]
Negative Vocalization	29.58	30.53	43.62	37.49	[-41.76, 13.67]
Positive Vocalization	3.63	5.41	1.83	1.69	[-1.85, 5.47]
Gestures	31.71	24.58	19.99	21.35	[-7.77, 31.20]
Autonomic	6.47	9.78	2.82	3.35	[-3.00, 10.30]
Self Comfort	41.33	42.89	33.70	30.99	[-24.71, 39.95]
Look at object	9.06	13.05	14.29	22.45	[-19.53, 9.08]
Look at adult	47.14	30.96	31.93	22.78	[-8.23, 38.65]
Look at new object	4.19	7.09	3.95	4.65	[-4.98, 5.47]
Distance	31.23	57.46	41.36	76.42	[-64.38, 44.13]
Smile	3.94	8.92	1.20	2.24	[-3.24, 8.72]
Reunion					
Gaze Aversion	41.96	29.23	36.85	30.68	[-20.07, 30.28]
Negative Vocalization	32.77	29.94	21.40	28.66	[-13.50, 36.24]
Positive Vocalization	6.79	13.05	6.37	11.00	[-9.96, 10.80]
Gestures	15.27	20.97	13.52	14.68	[-14.09, 17.60]
Autonomic	3.36	5.80	2.46	4.06	[-3.49, 5.28]
Self Comfort	21.72	25.52	13.09	13.29	[-9.59, 26.85]
Look at object	9.61	13.24	12.41	15.79	[-14.87, 9.27]
Look at adult	50.68	24.99	38.85	30.41	[-11.17, 34.83]
Look at new object	3.72	5.33	3.10	3.14	[-3.27, 4.50]
Distance	3.30	5.61	6.13	12.46	[-10.38, 4.72]
Smile	9.74	18.13	9.72	22.34	[-16.77, 16.81]

Note. N=26 for all analyses; *p<.05, **p<.01

Table 11
Difference in Interactional Synchrony Between High and Low Risk Infants

	Low Risk		High Risk		
	M	*SD*	*M*	*SD*	*CI*
Matching Codes					
Avert Gaze	1.19	1.91	2.44	4.85	[-4.06, 1.54]
Object Attend	.06	.25	6.33	14.31	[-13.55,1.01]
Mutual Gaze	170.06	93.78	134.78	90.02	[-44.44. 115.00]
Smiles	28.19	46.81	29.22	56.39	[-44.43, 42.36]

Note. N=26 for all analyses; *p<.05, **p<.01

Appendix A

Still Face Experiment Coding System

Adapted with permission from Edward Z. Tronick & M. Katherine Weinberg's *Infant Regulatory Scoring System (IRSS) & Maternal Regulatory Scoring System (MRSS)*

ADAPTED INFANT REGULATORY SCORING SYSTEM

GAZE: L1. LOOKS AT ADULT'S FACE
L33. LOOKS AT NEW OBJECT
L3. LOOKS AT SAME OBJECT
L4. LOOKS AWAY
L5. EYES CLOSED

VOCALIZATION:
V1. NEUTRAL/POSITIVE
V3. NEGATIVE/FUSSY
V4. CRYING

GESTURES:
G1. REACH
G4 TOUCH
G5. LEAN FORWARD

SELF-COMFORT:
C1. ORAL
C4. TOUCHES SELF
C5. SELF-CLASP
C6. ROCK

DISTANCE: D1. DISTANCE

AUTONOMIC INDICATORS:
T1. SPIT UP/HICCUP/YAWN

OTHER: OT

ADAPTED MATERNAL REGULATORY SCORING SYSTEM

PX. PROXIMITY TO INFANT
- PX1. NOSE TO NOSE
- PX2. LOOM
- PX3. AVERAGE
- PX4. BACK

SE. SOCIAL ENGAGEMENT
- SE1. SOCIAL ATTEND
- SE3. AVERT GAME

OE. OBJECT ENGAGEMENT
- OE1. OBJECT ATTEND

A. AVERT
- A1. AVERT

V. VOCALIZE
- V1. DIRECTS TO SELF
- V2. SINGS
- V3. NEGATIVE COMMENT ABOUT INFANT
- V4. POSITIVE COMMENT ABOUT INFANT
- V7. NEGATIVE COMMENT ABOUT SELF
- V8. POSITIVE COMMENT ABOUT SELF
- V9. MOUTH NOISE

CG. CAREGIVING

T. TOUCH
- T1. TOUCH/STROKE/TAP
- T2. HOLD
- T3. REPOSITION INFANT
- T4. POKE/JAB/TICKLE/PINCH
- T7. RHYTHMIC MOVEMENT OF LIMBS
- T8. ROCK
- T9. KISS
- T11. SUCK ON INFANT

E. ELICITS
- E1. USE OBJECT
- E2. MAKE NOISE
- E3. WAVE
- E4. REPOSITION SELF
- E5. BLOW

OT. OTHER